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Stochastic valuations in reward design

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## INTRODUCTION

- Why use stochastic valuations?
- How the models work
- Examples
- Opportunities for actuaries

## WHY USE STOCHASTIC VALUATIONS?

HR Director/Remuneration Committee:

How do I compare the value of these packages?

	Company A	Company B
Base salary	650	500
Bonus	60%	100%
Options	3 x salary, vest 50% if EPS > RPI + 3%, 100% if EPS > RPI + 7%, 2 retests	1 x salary, vest if EPS > RPI + 3%, no retests
Performance shares	None	1 x salary, vest 50% if median against FTSE 100 if upper quartile
Pension	1/30ths	40% of salary

## WHY USE STOCHASTIC VALUATIONS?

### Association of British Insurers:

"The cost of share incentive schemes (and any amendments to existing schemes) should be disclosed at the time shareholder approval is sought in order that shareholders can assess the benefits of the proposal against the total costs and award justification. The following information should be disclosed: ...

The expected value of the award at the outset, bearing in mind the probability of achieving the stipulated performance criteria...

The use of phased grants of share options and restricted shares, and utilisation of both new and purchased shares to satisfy the vesting of awards, requires a comprehensive approach to valuation. Assessment should focus on expected value, which should be disclosed, and it should take account of the performance vesting schedule which is adopted as well as the existence of any "retesting" and "replacement option" facilities such as have been prevalent under traditional schemes. Shareholders are helped in this task by disclosure of face value of any share award or option grant as well as of expected value".

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## WHY USE STOCHASTIC VALUATIONS?

### Association of British Insurers:

"The concept of expected value (EV) should be central to assessment of share incentive schemes. Essentially, EV will be the present value of the sum of all the various possible outcomes at vesting or exercise of awards. This will reflect the probabilities of achieving these outcomes and also the future value implicit in these outcomes. The calculation of the EV of share schemes is often complex and relies on a range of assumptions, and reliance on this concept by Remuneration Committees will require a sufficient measure of disclosure to enable shareholders to make informed judgments about such arrangements.

The nature of performance hurdles governing exercise is also crucial to calculations of EV and it must also be recognised that any facility for "retesting" will also increase the EV of the award whereas in contrast if the exercise price is set at a premium to the share price at the outset, this will reduce the value of the EV of the instrument".

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## WHY USE STOCHASTIC VALUATIONS?

### International Accounting Standards Board:

"For equity-settled share-based payment transactions, the entity shall measure the goods or services received... by reference to the fair value of the equity instruments granted..."

"The fair value of the options granted shall be estimated by applying an option pricing model... if a grant of shares or options is conditional upon satisfying specified vesting conditions, these conditions shall be taken into account when an entity measures the fair value of the shares or options granted"

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## WHY USE STOCHASTIC VALUATIONS?

- Various parties are interested in placing a value on executive incentives:
  - Companies/RemCos for benchmarking/design
  - Investors for disclosure
  - Standard setters for accounts
- But why use a stochastic model

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## WHY USE STOCHASTIC VALUATIONS?

- Recall the company A option plan:
  - If  $EPS > RPI + 3\%$  pa 50% vests after 3 years
  - If  $EPS > RPI + 7\%$  pa 100% vests after 3 years
  - 2 opportunities to retest at years 4 and 5
- Expected EPS growth in company A is 12% pa
- Current share price is £1

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## WHY USE STOCHASTIC VALUATIONS?

### A simple approach:

- If  $RPI = 2\%$  pa, expected real growth is 10%
- So assume 100% vests
- Gilt yields are 4.5%, beta of company A is 1, assume 3% equity risk premium, no dividends
- So assume 7.5% share price growth
- Discount rate? Why not 7.5%?

$$\text{Value} = 1.075^3 \times 100\% \times (1.075^5 - 1) = £0.20$$

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## WHY USE STOCHASTIC VALUATIONS?

But...

- What if only 20% vests at RPI + 3% pa?
- What if you need RPI + 10% for 100% to vest?
- What if there are 3 retests?
- What if there are no retests?
- What if there is rolling retesting?
- What if there is 25% bonus option if  $EPS > RPI + 20\%$ ?

None of these would have changed our simple valuation

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## WHY USE STOCHASTIC VALUATIONS?

Remember what the ABI says:

"The nature of performance hurdles governing exercise is also crucial to calculations of EV and it must also be recognised that any facility for "retesting" will also increase the EV of the award whereas in contrast if the exercise price is set at a premium to the share price at the outset, this will reduce the value of the EV of the instrument".

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## WHY USE STOCHASTIC VALUATIONS?

We need to use stochastic valuations because:

- They are the only way to take into account all of the features of complex incentives
- They are demanded by companies, investors, standard settlers
- You can get in terrible trouble with simplistic approaches
- They are a well established and understood way of valuing derivatives
- They are actually very easy

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## HOW THE MODELS WORK

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“Options, Futures, and Other Derivative Securities”

John C Hull

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## HOW THE MODELS WORK

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- Monte Carlo?
- Or
- Binomial?

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## HOW THE MODELS WORK

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### Monte-Carlo models:

- Essentially discounted cashflow models
- Run 10,000 times under different scenarios
- Take an average to get stochastic valuation
- Need a bit of care in choosing assumptions

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## HOW THE MODELS WORK

- Usually assume variables are normally or lognormally distributed
- For each variable we need:
  - Mean growth rate
  - Volatility
  - Correlation with other variables
- Assumptions chosen according to risk-neutral methodology [more later]

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## HOW THE MODELS WORK

- Going back to our option plan:
- Each of the 10,000 simulations produces a series of EPS and share price projections:
  - $S_0, S_1, \dots, S_{10}$
  - $EPS_0, EPS_1, \dots, EPS_{10}$
- For each simulation,  $i$ , we have enough data to calculate present value pay-out  $P_k$
- Can take into account all plan features
- Value is then the average  $P_k$

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## HOW THE MODELS WORK

Monte-Carlo approach is not the only approach but is:

- Very flexible
  - Performance conditions
  - Turnover
  - Exercise patterns
- Simple (just need a spreadsheet)
- Good enough
- Widely used/accepted

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## HOW THE MODELS WORK

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### Assumptions:

- Volatility and correlations usually just historic
- How to choose mean growth and discount rate?
- Temptation to use "realistic" growth rates
- But then what about discount rates?
- Fortunately this is just derivative pricing, which is well understood

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## HOW THE MODELS WORK

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### Risk neutral assumptions:

- A miracle
- Everything grows and is discounted at the risk free rate\*
- Two stupid assumptions...
- ... but the errors always cancel
- Worth understanding

\* well, most things

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## HOW THE MODELS WORK

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### Problems and possible solutions:

- Lognormal is unrealistic:
  - Parametric distributions
  - Jump diffusion
  - Time series models
- Volatility is not constant
  - Stochastic volatility models

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## HOW THE MODELS WORK

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### Problems and possible solutions:

- More complex approaches rarely used even by derivatives practitioners
- Risk-neutral approach breaks down
- Tendency to generate more assumptions
- Not worth it in executive remuneration

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## EXAMPLES

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- How we use the models

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## OPPORTUNITIES FOR ACTUARIES

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- Increasing demand for skills of valuation and analysis in executive remuneration
- Understanding of finance and remuneration makes actuaries well-placed
- Actuaries can make good executive remuneration consultants
- An interesting change from pensions!

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## CONTACTS

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